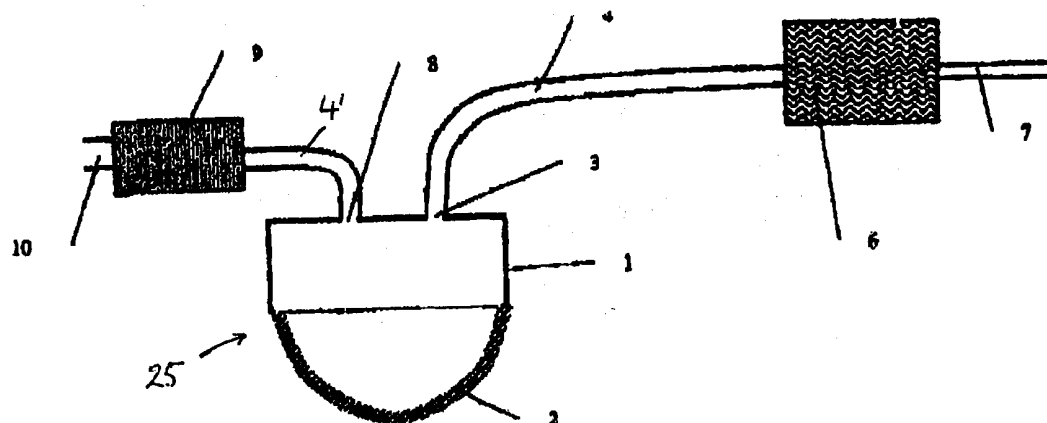




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : B41F 17/30, 17/00	A1	(11) International Publication Number: WO 00/61371 (43) International Publication Date: 19 October 2000 (19.10.00)
(21) International Application Number: PCT/BE00/00032 (22) International Filing Date: 10 April 2000 (10.04.00) (30) Priority Data: 9900245 8 April 1999 (08.04.99) BE (71) Applicant (for all designated States except US): PRINTING INTERNATIONAL [BE/BE]; Industriepark, Ambachtenlaan 12, B-9880 Aalter (BE). (72) Inventor; and (75) Inventor/Applicant (for US only): DE VOLDER, Laurent [BE/BE]; Aalterstraat 11, B-9880 Aalter (BE). (74) Agent: VAN CUTSEM, Paul; Avenue Winston Churchill 152/6, B-1180 Bruxelles (BE).	(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Dutch).</i>	

(54) Title: FLEXIBLE STAMP APPARATUS FOR PRINTING THREE-DIMENSIONAL SPHERICAL OR CURVED OBJECTS



(57) Abstract

Apparatus for printing three-dimensional objects, particularly objects having a substantially spherical shape, comprising a pad for printing by means of pad printing, wherein said pad has a silicon shape with a determined thickness, which is mounted on a hollow pad holder (1) made of an undeformable material which constitutes an isolated space together with said silicon shape (2), which is supplied with compressed air and which is connected to a pressure vessel by means of a main element (4) provided therefor through an opening (3), characterised in that the apparatus is arranged in open loop, wherein there is provided an additional separate aperture (8) for a separate inlet and outlet of air (3, resp. 8), with a pressure regulating unit (6) enabling to keep the pressure in the pad greater than or at a preset level P, wherein said pressure regulating unit (6) regulates the compressed air which enters the regulator through a supply main (7).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

**Flexible stamp apparatus for printing three dimensional
spherical or curved objects**

Field of the invention

- 5 This invention relates to a flexible stamp apparatus for printing three dimensional spherical and/or curved objects.

Prior art

- 10 It is presently known to use a hollow, half silicon spherical shape for printing spherical objects, such as toy balls. This silicon shape has a thickness of about 2 cm and it is mounted on a hollow flexible stamp or pad holder. The silicon shape and the pad holder are designated hereafter as "the pad".

- The pad holder is made of an undeformable material and has the shape of a drum.
15 It forms together with the silicon shape, an hermetically closed space having only one aperture as contact with the outside. At this sole aperture, a flexible tube having a sufficiently great diameter is connected to a pressure vessel. Said pressure vessel is not represented at scale. This pressure vessel needs to have a volume which can contain 10 to 100 times the volume of the pad indeed. The
20 pressure vessel is yet generally kept under a light over-pressure by means of a separate pressure regulator.

- This construction serves for keeping the pressure in the pad as constant as possible during the printing cycle. Indeed, a pressure variation in the pad results in
25 the dilatation or the retraction of the silicon part. Owing to this, the image on the silicon part becomes bigger or smaller with a bad printing quality on the printed spherical objects. The different times of the printing cycle of the prior art show subsequently a rest position wherein the pressure in the pad is equal to the one in the pressure vessel. This pressure is designated hereafter with the reference P.

- 30 The pad is moved from the rest position to said object to be printed in a relative movement according to arrow F and it bends over the object to be printed. The air

in the pad is pressed to the pressure vessel through the flexible tube. However, despite the fact that the volume of the pressure vessel is several times greater than the content of the pad, this displacement of air volumes yet results in a slight increase of the pressure in the pad and vessel, which is designated hereafter by the reference P'.

After this, the pad returns to its original state according to the direction of arrow F, i.e. to the rest position. The air now moves back from the pressure vessel to the pad. The pressure in the system now becomes greater than P, which is referred to hereafter with P'', but during this part of the cycle, the latter decreases again so as to become pressure P again.

The above-mentioned known system is a closed circuit wherein the air, which is pressed out of the pad during the printing and inking stage, goes back to the pressure vessel. When the pad goes back to its original position, the air returns to the pad again from the pressure vessel.

The great advantage of this system consists in that despite the fact that the volume of the pressure vessel is several times greater than the volume of the pad, there is still a small pressure variation, i.e. P, P', P'', which affects unfavourably the printing quality during the pad action on the objects to be printed.

Aim of the invention

This invention aims at remedying the above-mentioned drawback. Thus in this invention, a hollow pad as above is used, wherein instead of using a closed circuit, the pad is now incorporated in an open circuit according to the invention.

Notwithstanding that the apparatus according to the invention has a lower air consumption, it yet enables determining the pressure in the pad in a very accurate way at each time of the printing cycle. This is a very important parameter for printing at least partially spherical objects, particularly in connection with the

printing quality thereof, the importance whereof increases as nowadays the requirements set for the printing quality are always becoming stronger.

Further properties and particularities are defined in the appended claims.

5

Some exemplary embodiments of the system according to the invention are described hereafter in the light of the appended drawings.

This invention also relates to a process for printing at least partially spherical
10 and/or curved three dimensional objects. It is to be understood that a substantially differentiating element in this invention consists in that an open loop is used here and not a closed loop, wherein in addition the inlet side and the outlet of the pad are clearly separated from each other. Thanks to this specific process according to the invention a remarkably higher printing quality is achieved.

15

Brief description of the drawings

Figure 1 is a schematic representation of a closed pad system for printing spherical objects such as known from the prior art.

Figures 2a to 2c are schematic representations of the various steps and states of
20 the known system during a (complete) working cycle.

Figure 3 is a schematic representation of an open system with a pad for printing spherical objects according to the invention.

Figure 4 is the functional representation of the schematic view of the apparatus according to the invention according to Figure 3.

25 Figures 4a to 4c represent in a schematic way the various steps and states of the apparatus according to the invention as represented in Figure 4 in its basic embodiment.

Figure 5 is the representation of a first alternative of the apparatus with pad for printing spherical objects according to the invention as represented schematically
30 in a basic embodiment in figure 4.

Figure 6 is the representation of a further alternative of the apparatus with pad for printing spherical objects according to the invention.

Figure 7 is the representation of a still further alternative of the apparatus with pad for printing spherical objects according to the invention.

Description

5 Figure 1 shows an apparatus with a pad holder 1 and a so-called silicone shape 2 which are comparable to the present prior art. However, in this pad holder 1, there is provided in addition to a traditional aperture 3 an additional aperture 8, resulting in that the system presents separate apertures for the inlet 3 of the air and respectively the outlet 8 of the air through a conduit 4, resp. 4' provided therefor. A fast and accurate pressure regulating unit 6 which is incorporated in the inlet 4
10 causes the pressure in the pad 25 never to fall under a preset level established at pressure P. Therefor the pressure regulating unit adjusts the compressed air which enters the regulator 6 through a supply flexible tube 7 according to F. An accurate and fast over-pressure valve 9 is connected to the outlet 8 of the pad holder
15 25 at the outlet hole 8. As soon as the pressure in the pad 25 becomes greater than the preset value of the pressure P, the over-pressure valve 9 will blow off according to G' to the outer air 40 through the outlet 10.

Different embodiments are described hereinafter after the preliminary description
20 of how the above described basic embodiment of the apparatus according to the invention works.

Figure 4a shows the apparatus in rest position represented by A. There is a constant pressure P in the pad 25. Both the pressure regulating system 6 and the
25 over-pressure valve 9 are in a closed position.

Figure 4b shows how the pad 25 moves downwards according to arrow H and how it bends over the object 30 to be printed (state B). The air in the pad 25 is pressed out of the pad according to G through the over-pressure valve 9 to the outside 40
30 according to the arrow direction G'. The pressure in the pad thus remains pressure P.

Figure 4c shows the subsequent state C wherein the pad 25 goes upwardly again according to - H, i.e. to the rest position A. The over-pressure valve 9 got closed and the pressure regulating unit 8 enters into action. The pressure regulating unit 8 will keep the pressure at pressure P by blowing the right quantities of air in the pad 25.

Despite the fact that the system according to the invention consumes more air, it enables determining very accurately the pressure in the pad 25 at each time of the printing cycle. This is a very important parameter for printing spherical objects 30, particularly with respect to the printing quality thereof, the more that nowadays ever stronger printing quality requirements get imposed.

Different embodiments and alternatives of the apparatus according to the invention are described hereinafter with Figures 6 to 8. The selection of a particular embodiment depends on various factors, such as printing speed, cost of the system and desired accuracy of the printing.

An alternative of the system with pad 25 with mechanical valves 6, 9 as described above brings a solution to the above-mentioned requirement for finding accurate and quick valves which are yet able to supply the required flow provided that an additional pilot valve 13 is incorporated in the system as shown on Figure 5.

In this Figure, said pilot valve 13 is connected directly on the air supply main 7 through a compressed air conduit 11. Further said pilot valve 13 is also directly connected to the pad 25, particularly the pad holder 1, through a measuring tube 12. Said pilot valve is also directly connected to said pressure regulating unit 6 through a control pressure conduit 14.

The latter alternative thus shows a pad 25 with mechanical valves 6, 9 and a pilot valve 13, wherein this pilot valve is fed through the compressed air conduit 11. Through the measuring tube 12 the pressure in the pad 25 is measured by the pilot

valve 13 and the pressure regulating system 6 is controlled through the control pressure conduit 14.

Figure 6 shows a further alternative of the system which comprises a pad 25 with
5 pressure sensors 19 and an electronic control unit 18. One or a plurality of pressure sensors 19 are incorporated in this alternative of the system at the pad 25, particularly the pad holder 1, with a direct connection to an electronic control unit 18 through a conduit 17. Said electronic control unit 18 is in turn connected to an electronic valve 6 at the admission side on the one hand and with an over-
10 pressure valve 9 of the same type as above on the other hand, in each case through a respective signal carrier 15 and 16.

The electronic pressure sensor 19 measures continuously the right pressure of the pad 25, wherein this information is taken up in the sensor signal s that is
15 delivered by said pressure sensor 19.

This alternative of embodiment shows at the input side between the pad 25 and the input 7 a simple pressure regulator 22 with a buffer vessel 20 streamdownwardly of the supplied compressed air, which is incorporated in the supply main 4, wherein a nonreturn valve 21 is provided at the inlet of the pad 25.
20

At the output of said pad, there is provided the same outlet branch as in the above alternatives, i.e. with an over-pressure valve 9.

25 The sensor signal s is transmitted to an electronic control unit 18, such as, e.g. a PLC, a micro-controller, a PC, an electronic regulator, and the like. In case the measured pressure lies under the programmed value, an electronic valve 6 is opened by a signal s_1 along the conduit 15 in order to admit compressed air in the pad 25 through the supply main. In case the pressure in the pad 25 is greater than
30 the value programmed in the control unit 18, another signal s_2 is sent to the electrical desaerating valve 9 through the conduit 16.

Figure 8 shows a still further alternative of embodiment which comprises a pad 25 with a buffer vessel and a nonreturn valve. In this embodiment, the same over-pressure valve 9 is used as in the basic embodiment above as shown in Figures 5 and 3 to 4c. However, the inlet is supplied here through a simple pressure regulator 22 which builds up a preset pressure in said buffer vessel 20 in between the printing cycles. An nonreturn valve 21 prevents the air which is pressed out of the pad 25 during a printing stage from returning to the buffer vessel 20, since this would increase the pressure in the buffer vessel. The air pressed out of the pad leaves the system through the over-pressure valve 9 as above. The supply main 4 has a sufficient diameter so as to be able to supply the required air flow each time the pad goes up again away from the printed object 30 after an inking or printing cycle.

It is further yet possible to use combinations of the embodiments described above, wherein it is to be understood that said combinations fall within the scope of protection of this application.

The process for printing surfaces of an object by means of the above-described apparatus consists in first pressing the pad against an initially inked surface, in an open loop, whereupon the half spherical surface of the pad, which is in close contact with this inked surface, is flattened so that the figures to be printed are transferred on the surface of the pad, in subsequently removing said pad from the original surface in order to enable the latter to recover its initial half spherical shape again, and in subsequently pressing said pad against the three dimensional spherical and/or curved surface in such a way that said pad encompasses at least a spherical or curved part of said object, and in bringing the pad surface bearing the inked figure in contact with the surface of said object, thereby to transfer this inked figure on the desired spherical or curved part of the receiving object.

CLAIMS

5 1.- Apparatus for printing three dimensional objects, particularly objects having a substantially spherical shape, comprising a pad for printing by means of pad printing, wherein said pad has a silicon shape with a determined thickness, which is mounted on a hollow pad holder (1) made of an undeformable material which constitutes an isolated space together with said silicon shape (2), which is supplied
10 with compressed air and which is connected to a pressure vessel by means of a main element (4) provided therefor through an opening (3), characterised in that the apparatus is arranged in open loop, wherein there is provided an additional separate aperture (8) for a separate inlet and outlet of air (3, resp. 8), with a pressure regulating unit (6) enabling to keep the pressure in the pad greater than
15 or at a preset level P, wherein said pressure regulating unit (6) regulates the compressed air which enters the regulator through a supply main (7).

2.- Apparatus according to the preceding claim, characterised in that there is provided an over-pressure valve (9) which is connected to the outlet (8) of the pad
20 holder (1) through a discharge conduit (4').

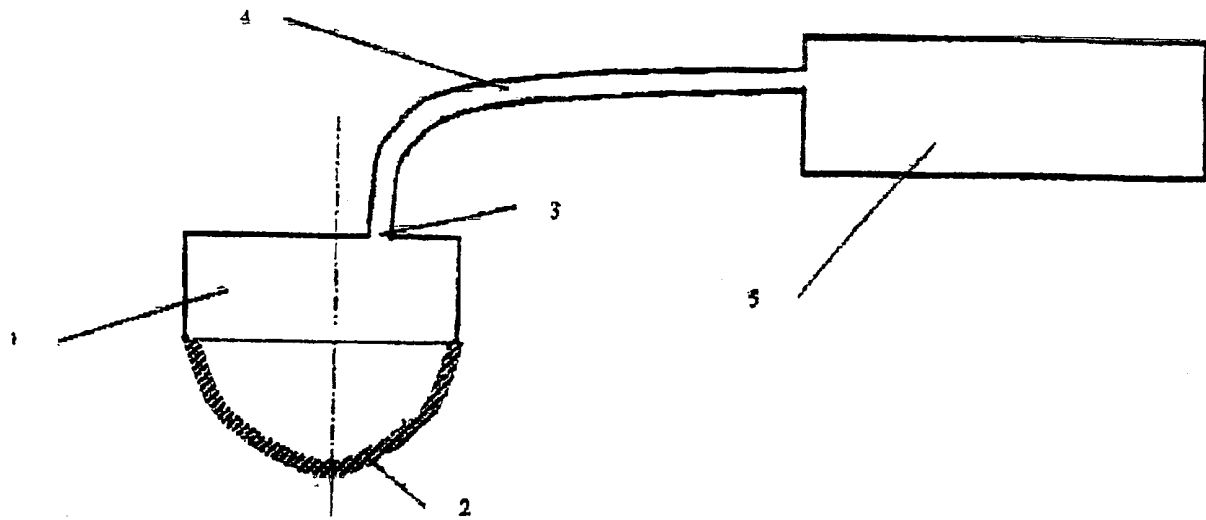
3 Apparatus according to claim 1 or 2, characterised in that the pad is provided with a pilot valve (13) which is fed through a compressed air main (11), and with a measuring unit (12) for measuring the pressure in the pad and
25 controlling the pressure regulating unit (6) through a control pressure conduit (14), which mutually connects the pilot valve (13) and the pressure regulating unit (6).

4.- Apparatus according to one of the preceding claims, characterised in that said pad (25) comprises pressure sensors (19) for measuring the pressure of the
30 pad (25), wherein the signal (s) delivered by said sensors (19) is transmitted to the electronic control unit (18).

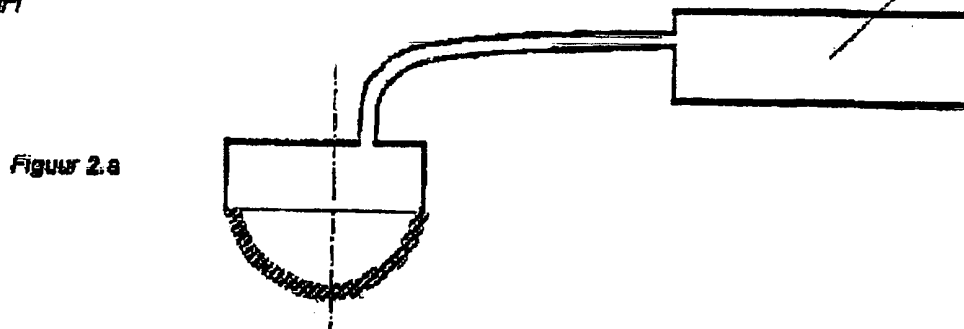
5.- Apparatus according to one of the preceding claims, characterised in that said pad (25) comprises a buffer vessel (20) and a nonreturn valve (21), wherein
35 the inlet is provided with a pressure regulator (22) which builds up a preset

pressure between the printing cycles in said buffer vessel (20) and wherein said nonreturn valve (21) prevents the air which is pressed out of the pad from returning to the buffer vessel (20) during a printing stage, wherein subsequently the air pressed out from the pad leaves the apparatus through the over-pressure valve (9), and wherein the supply main (4) has a sufficient diameter for supplying the needed air flow each time the pad returns to its rest position (A) after an inking or printing cycle.

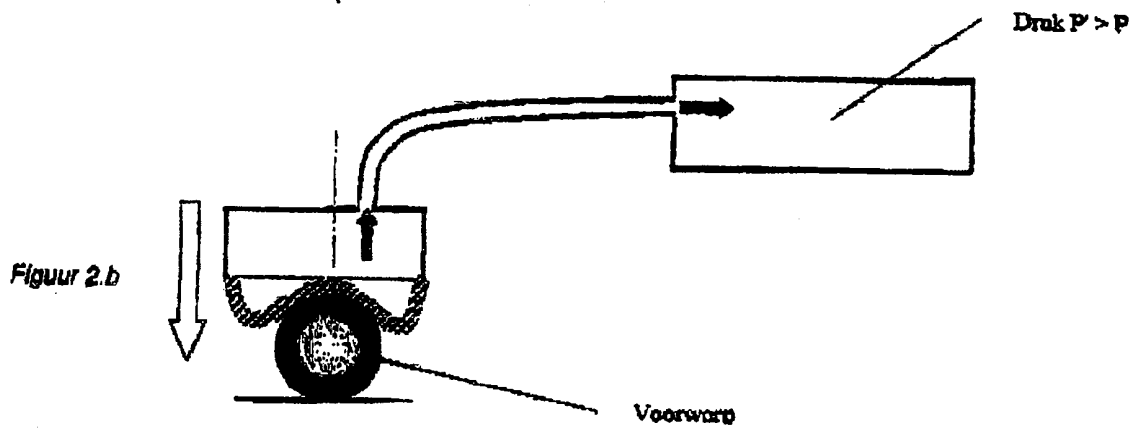
6.- Process for printing surfaces of an object by means of an apparatus according to one of the preceding claims, characterised in that it consists in first pressing the pad against an initially inked surface, in an open circuit, whereupon the half spherical surface of the pad, which is in close contact with this inked surface, is flattened so that the figures to be printed are transferred on the surface of the pad; in subsequently removing said pad from the original surface in order to enable the latter to recover its initial half spherical ~~dome~~ again, and in subsequently pressing said pad against the three dimensional spherical and/or curved surface in such a way that said pad encompasses at least a spherical or curved part of said object, and in bringing the pad surface bearing the inked figure into contact with the surface of said object (30) thereby to transfer this inked figure on the desired spherical or curved part of the receiving object.



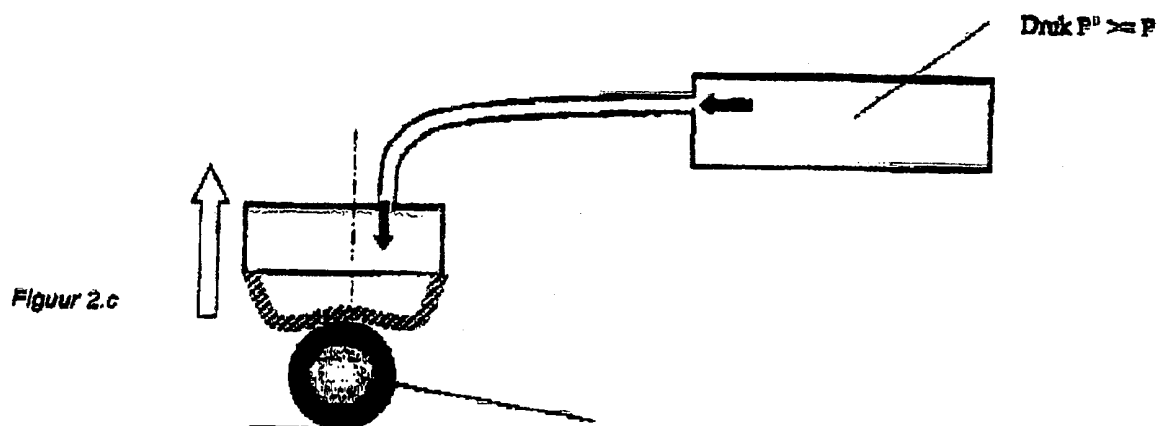
Figuur 1



Figuur 2.a



Figuur 2.b



Figuur 2.c

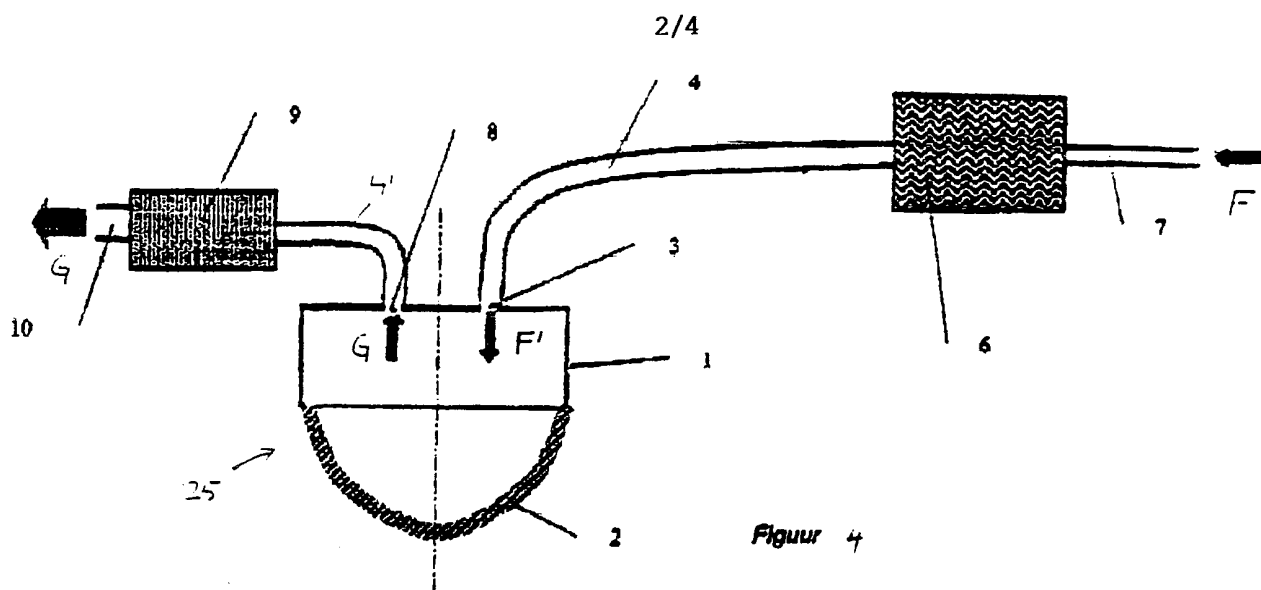


Figure 4.a

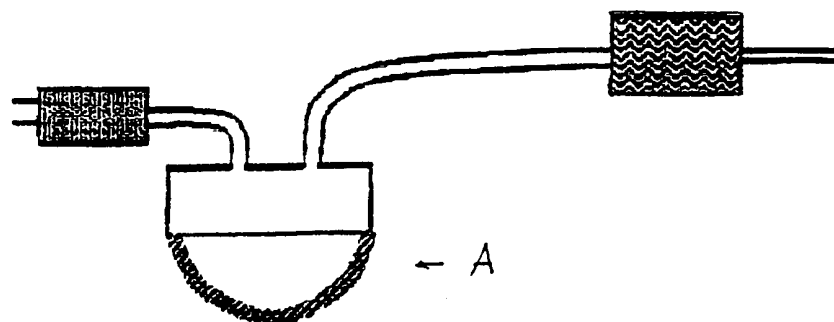


Figure 4.b

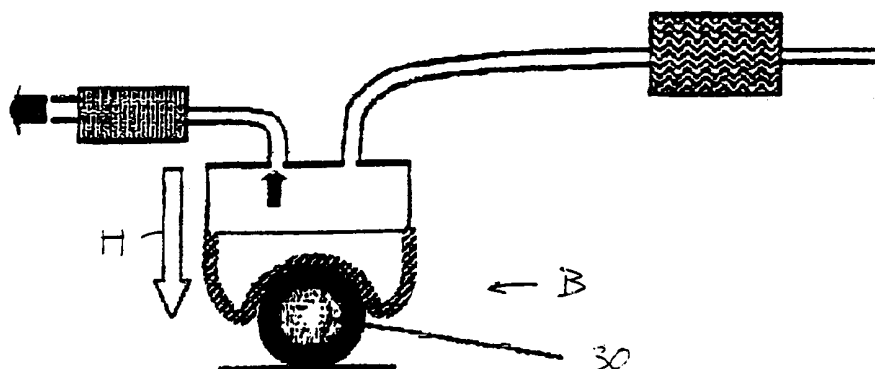
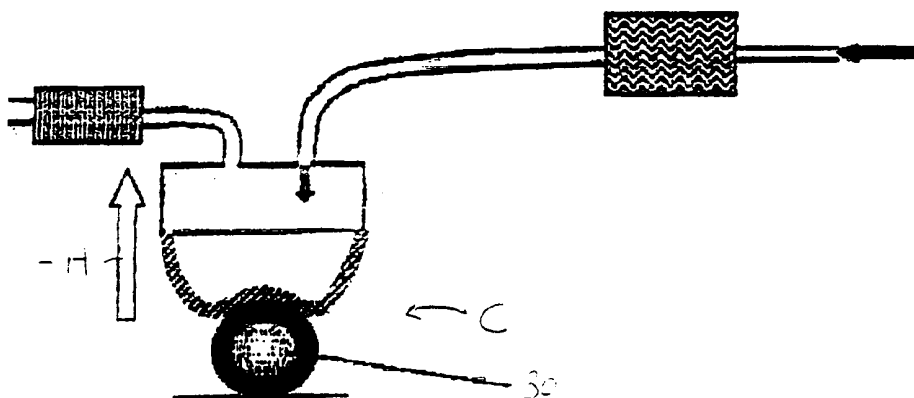


Figure 4.c



3/4

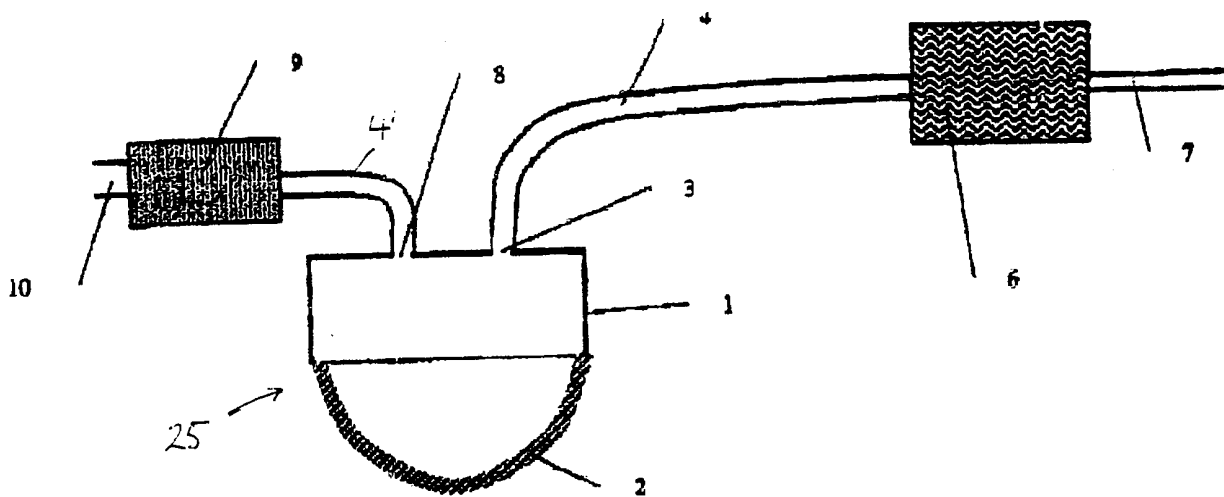


Figure 3

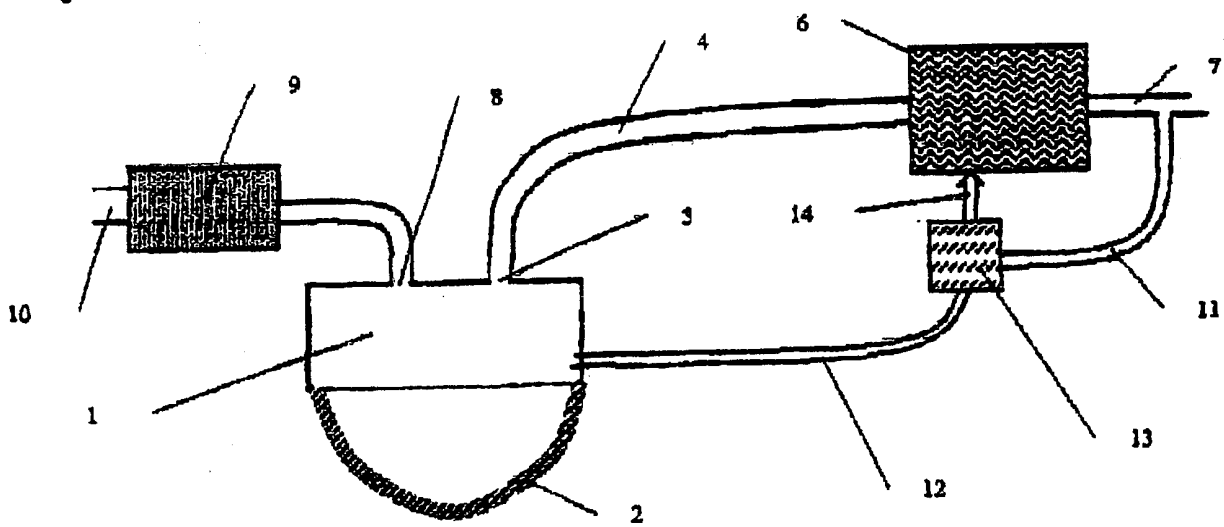


Figure 4

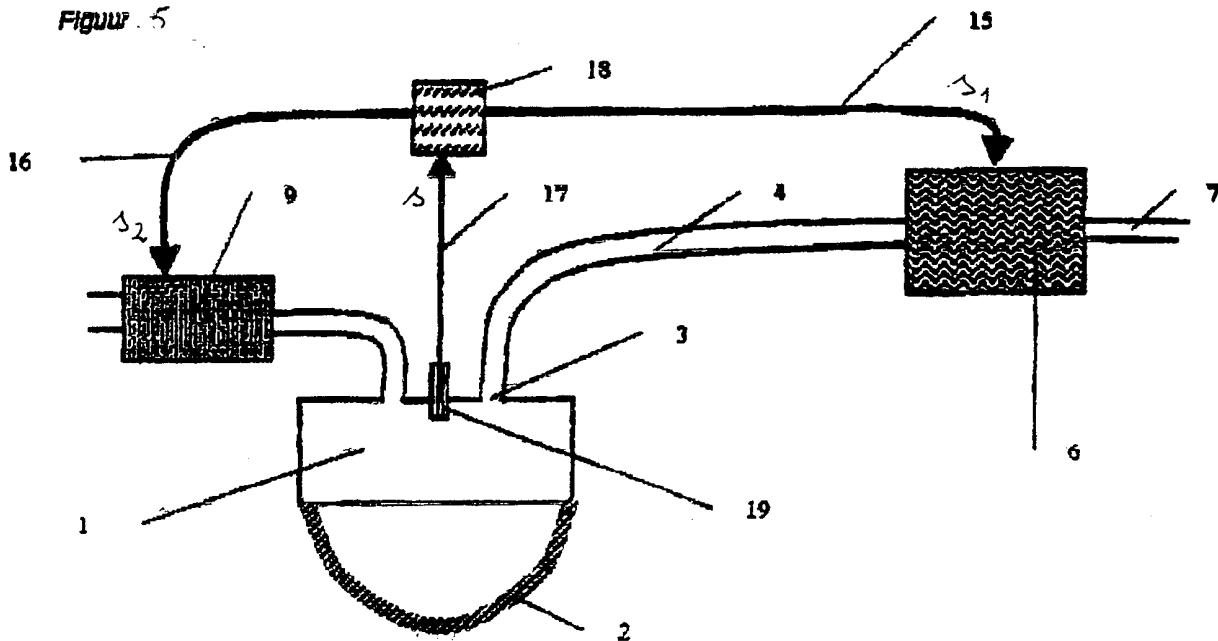


Figure 5

4/4

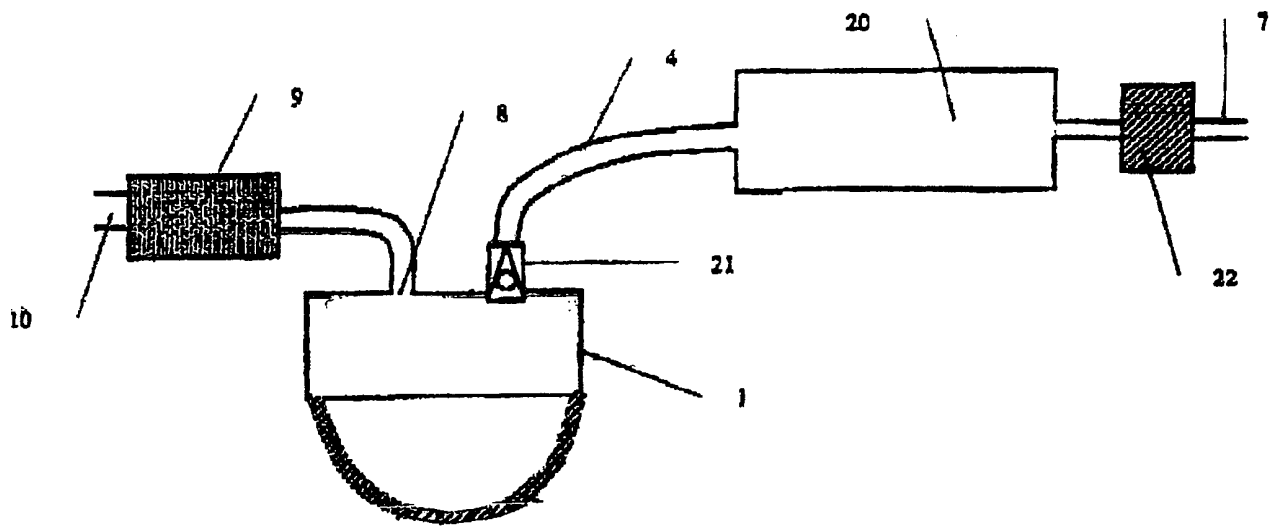


Figure 7

INTERNATIONAL SEARCH REPORT

Int. l. Application No

PCT/BE 00/00032

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B41F17/30 B41F17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B41F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 87 00796 A (UNICE SA) 12 February 1987 (1987-02-12) the whole document -----	1,6

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

7 August 2000

Date of mailing of the international search report

16/08/2000

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Madsen, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/BE 00/00032

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 8700796 A	12-02-1987	ES 545755 D	01-03-1987
		ES 8703346 A	01-05-1987
		DE 3668136 D	15-02-1990
		EP 0233895 A	02-09-1987